In Situ HAB Monitoring of the FDEP Gulf dispersal of Piney Point treated waste water
Report covering the October 1 to 3, 2003 monitoring cruise

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Introduction

Monitoring for Harmful Algal Blooms (HAB) during the dispersal of treated Piney Point waste water in the Gulf of Mexico is conducted at approximately biweekly intervals using vessels chartered from the Florida Institute of Oceanography (FIO). The overall objectives of the program are to collect samples that can be used to determine: 1. the presence of HAB species, 2. increases in biomass of phytoplankton populations, and nutrient concentrations. The specific objectives of this component of the HAB monitoring program are 1. to conduct a survey of surface waters along two transects within the dispersal region and provide maps of temperature, salinity, chlorophyll fluorescence, and light transmission; 2. Provide CTD profiles at fourteen locations outside of and within the dispersal area (Fig. 1) and collect surface and mixed layer samples that will be used for the analysis of chlorophyll-a concentration, phytoplankton species counts, and nutrient concentrations. The latter two analyses (counts and nutrients) will be performed by others and reported separately.

Methods

CTD profiles are taken at fourteen stations along two transects that traverse the area where water dispersal occurs (Fig. 1). Stations 1 and 14 are located shoreward of the permitted dispersal zone and should be indicative of West Florida Shelf waters without Piney Point water additions. These two stations should also allow us to estimate if treated water moved shoreward.

Surface underway measurements are made along each transect using a Falmouth Scientfic MicroCTD3 system coupled to a SeaPoint fluorometer, SeaPoint turbidity meter, and a WetLabs 10cm transmissometer measuring light transmission at 660 nm. The instruments are place into a darkened vessel through which surface sea water is continuously circulated. Output of the CTD system is merged with GPS Latitude and Longitude and stored for later averaging and plots using Surfer ^{R} software.

Water samples are collected at three depths (surface, mixed layer, and subsurface chlorophyll maximum) in darkened 250 ml bottles for chlorophyll-a analysis. All samples are filtered through GF/F glass fiber filters on board ship and immediately placed into 100% Methanol before storage at –20^{o}C until extraction and fluorometric analysis in the laboratory following the method described by Holm-Hansen and Reimann (1979).

Data from the CTD profiles are averaged at 1 meter intervals using SeaSoft ^{R} software and plotted with Surfer ^{R} .

Results and Discussion

CTD transects

Individual station plots of all CTD casts taken during this cruise are shown if Appendix 1. Reduced surface salinity was noted only along the eastern part of the transects e.g. Station 2 on Transect 1 and Stations 12 to 14 along Transect 2. The composite salinity profiles confirm that reduced salinity (below 35) was only present along the eastern edge of the discharge area (Figs.2 and 3). This reduced salinity layer was confined to the upper 15 to 25 meters of the water

column (Figs. 2 and 3). The mixed layer became progressively deeper toward the western boundary of the transects being essentially isohaline and isopycnal to 50 meters at stations 7 and 8.

In vivo chlorophyll fluorescence profiles at stations along the eastern boundary of the transects show single or multiple subsurface chlorophyll maxima (SCM) within the upper 50 meters. Further westward the SCM is found at the base of the mixed layer around 50 to 60 meters. Surface fluorescence values are typically low and do not reflect any growth enhancement due to elevated nutrients associated with discharged water.

Extracted chlorophyll-a and phaeopigment concentrations (Table 1) for surface samples for all locations were <0.4 μg/l and are higher than chlorophyll concentrations measured at the same locations during previous cruises (Table 2). Values at Stations 1 and 3 are almost double the previous months while concentrations at Stations 5 and 6 are essentially equivalent to September values (Table 2). Although these values are within the expected range for this region of the West Florida Shelf they are at the upper end of the expected range for an area of equivalent distance offshore (Vargo et al., 2001) that was sampled during the ECOHAB:Florida program. A malfunction in the CTD rosette system did not allow collection of subsurface water samples so absolute values for the SCM defined by the *in vivo* fluorescence profiles were not available for this cruise.

Surface underway measurements (Appendix 2) also confirm the presence of lower salinity water in the NE quadrant of the disposal area. The sampling transects are shown as "+" symbols and the route of the barge is shown in white or red solid circles in these figures. Temperature within this region is also somewhat lower than in the western quandrants suggesting that the lower salinity water may be of coastal origin since coastal waters tend to cool faster at this time of year than shelf or offshore waters. The core of elevated chlorophyll fluorescence and reduced light transmission is also associated with the region of reduced salinity. Contour lines for temperature and salinity suggest a strong front at the eastern edge of the disposal area which may be related to the edge of the anti-cyclonic eddy seen in Figures 1 and 2 of Report #10 by Hu et al. Such fronts are often regions of particle accumulation and enhance chlorophyll concentration.

References

Holm-Hansen, O. and B. Reimann. 1979. Chlorophyll a determinations: Improvements in methodology. OIKOS 30: 438-441.

Vargo, G.A., C.A. Heil, D. Spence, M.B. Neely, R. Merkt, K. Lester, R.H. Weisberg, J.J. Walsh and K. Fanning.2001. The Hydrographic regime, nutrient requirements, and transport of a *Gymnodinium breve* Davis red tide on the West Florida shelf. Proceeding of the IXth International Conference on Harmful Algal Blooms, Feb 7-11, 2000. Hobart, Australia. G.M. Hallegraeff, S. I. Blackburn, C.J. Bolch, and R.J. Lewis (eds.), pp. 157-160.

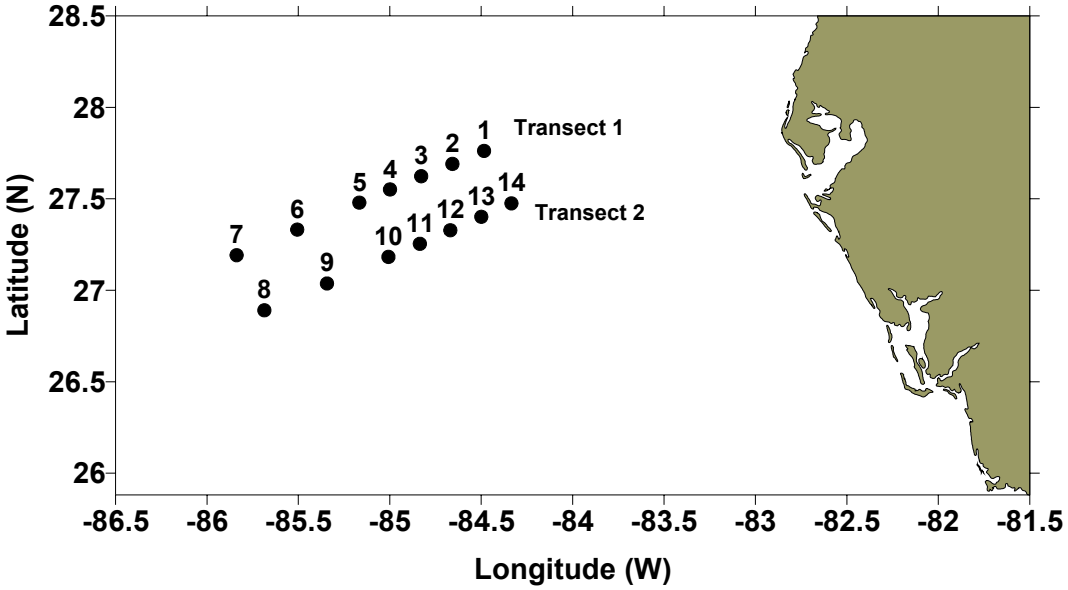


Fig. 1: Location of Stations for CTD profiles and sampling during dispersal of treated water from the Piney Point phosphate plant.

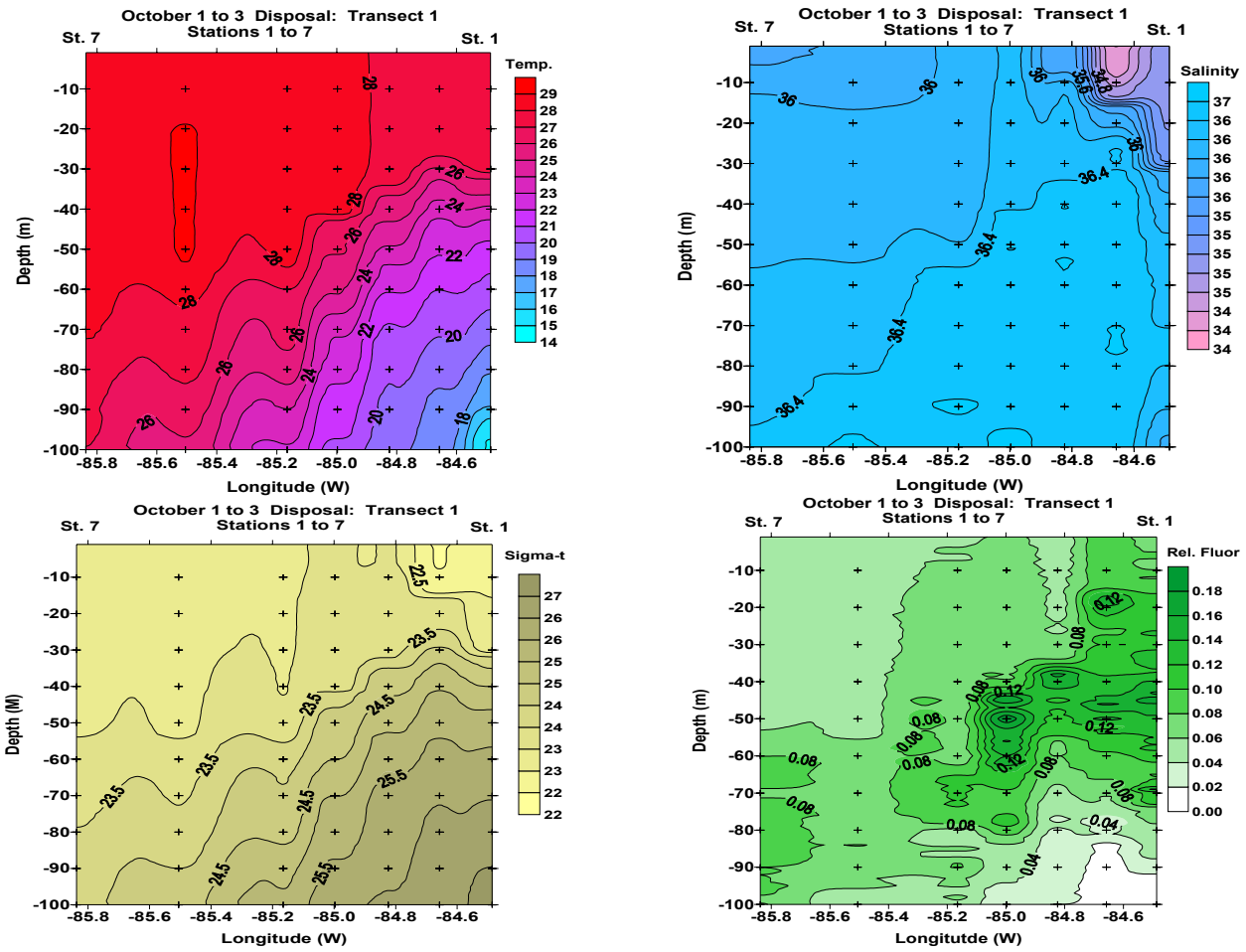


Figure 2: October 1 to 3 composite CTD profiles along Transect 1 that includes Stations 1 to 7

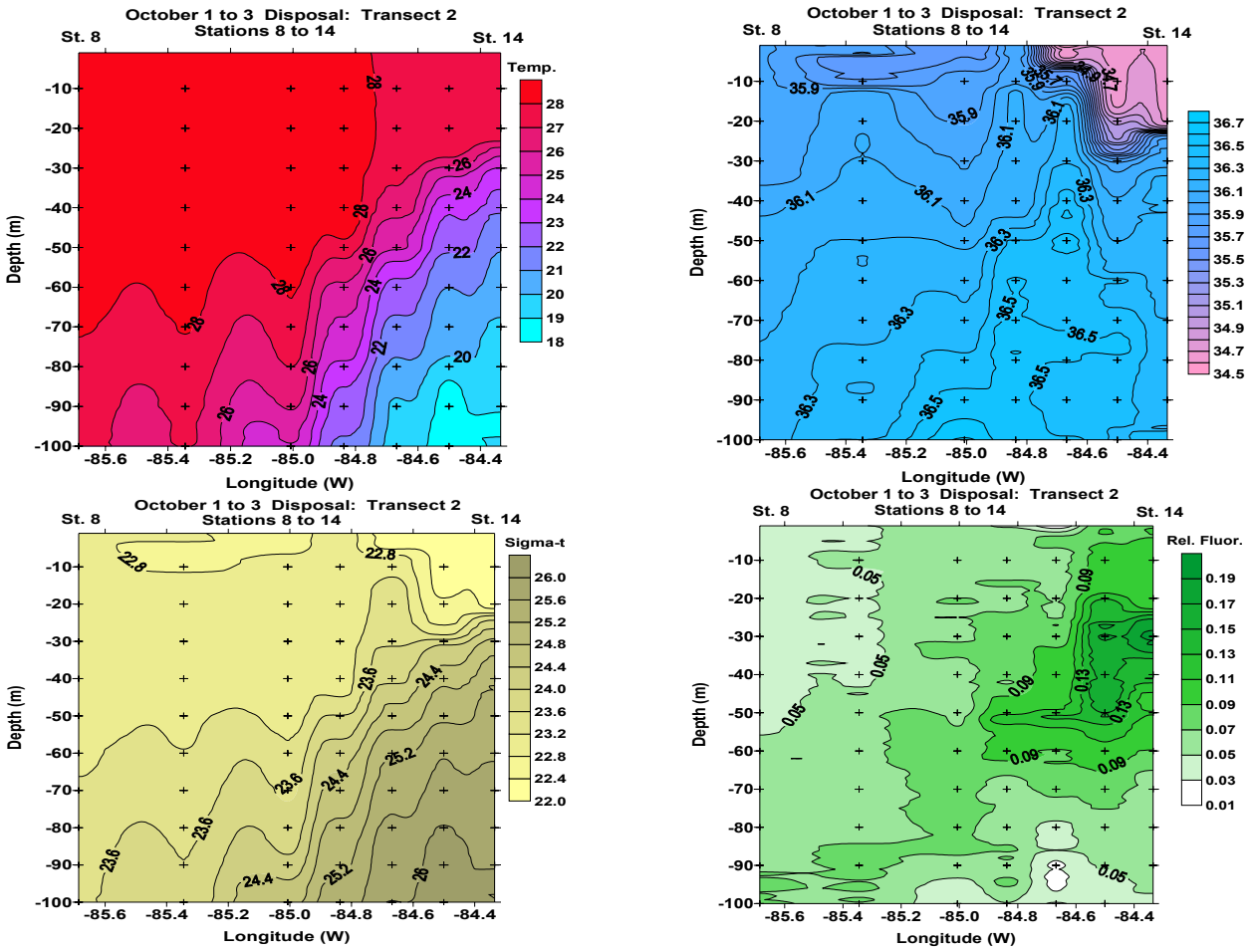
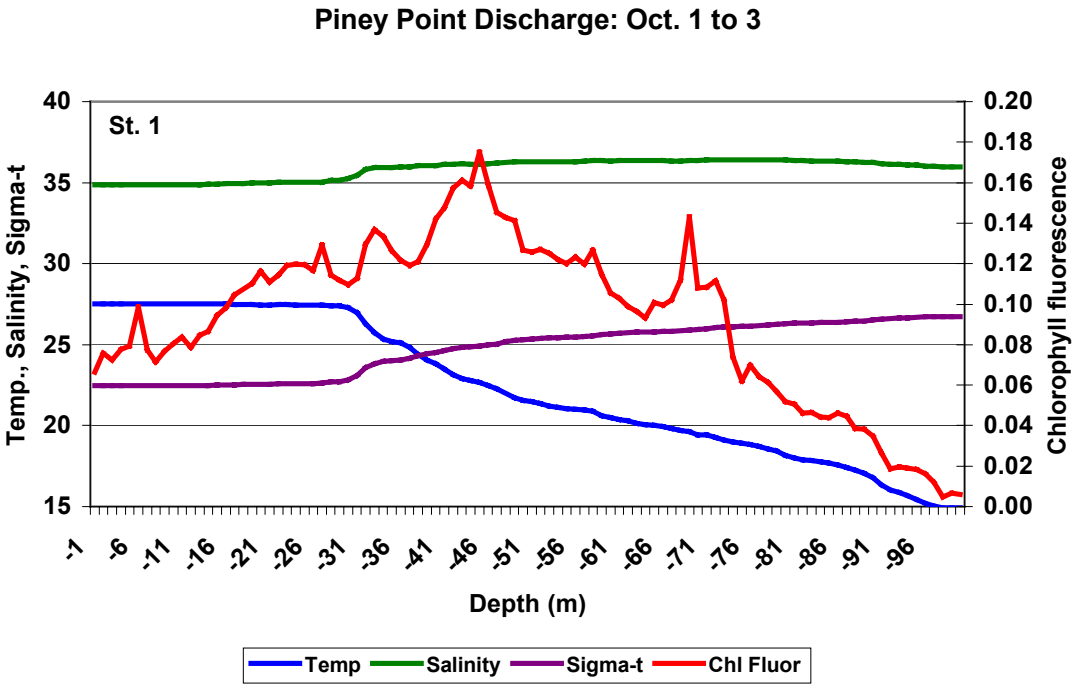
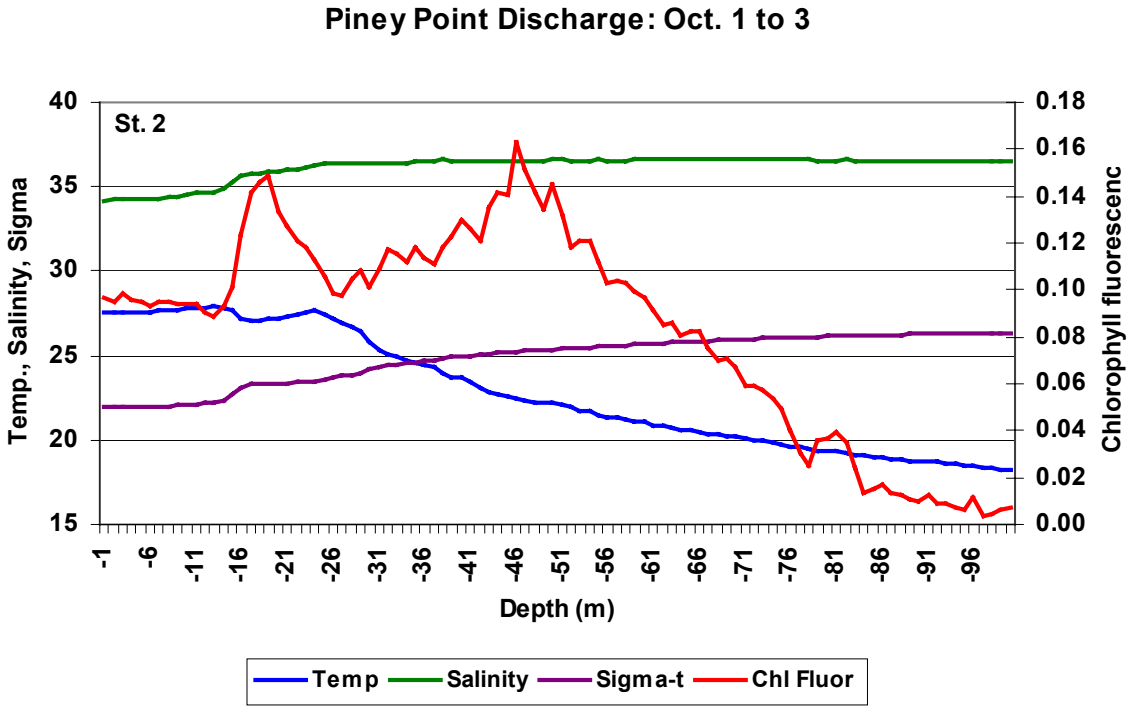
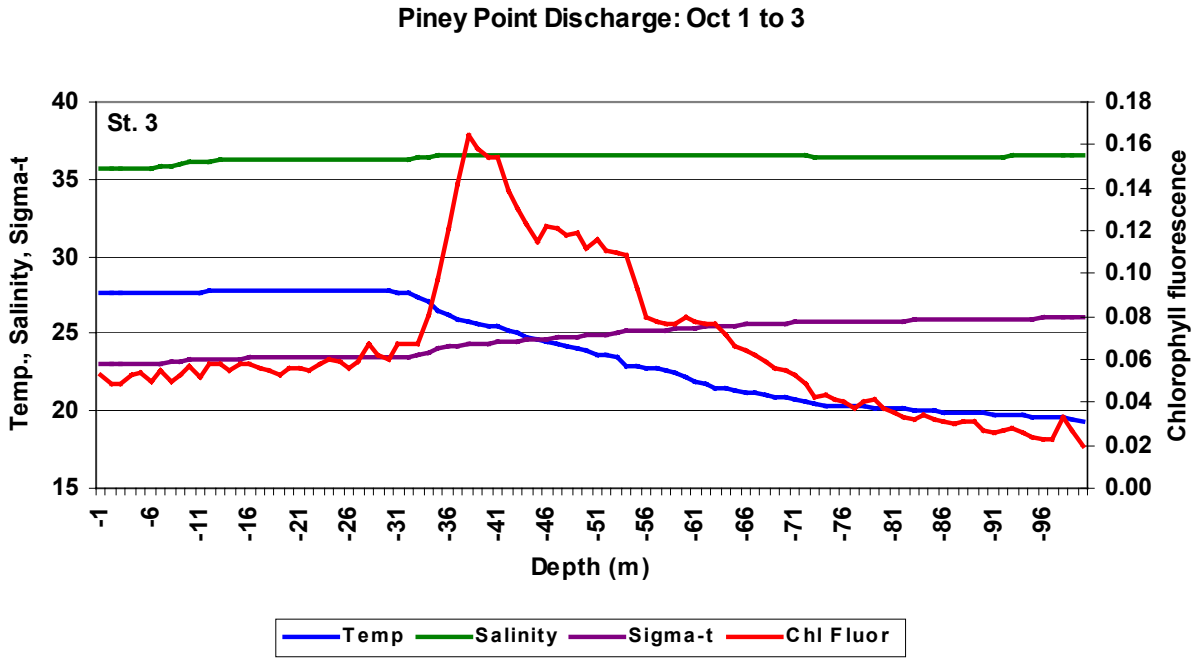


Figure 3: October 1 to 3 composite CTD profiles along Transect 2 that includes Stations 8 to 14.

Appendix 1


Piney Point Discharge: Oct. 1 to 3
St. 1
Temp., Salinity, Sigma-t
Chlorophyll fluorescence
Depth (m)
Temp
Salinity
Sigma-t
Chl Fluor


Piney Point Discharge: Oct. 1 to 3
St. 2
Temp., Salinity, Sigma
Chlorophyll fluorescenc
Depth (m)
Temp
Salinity
Sigma-t
Chl Fluor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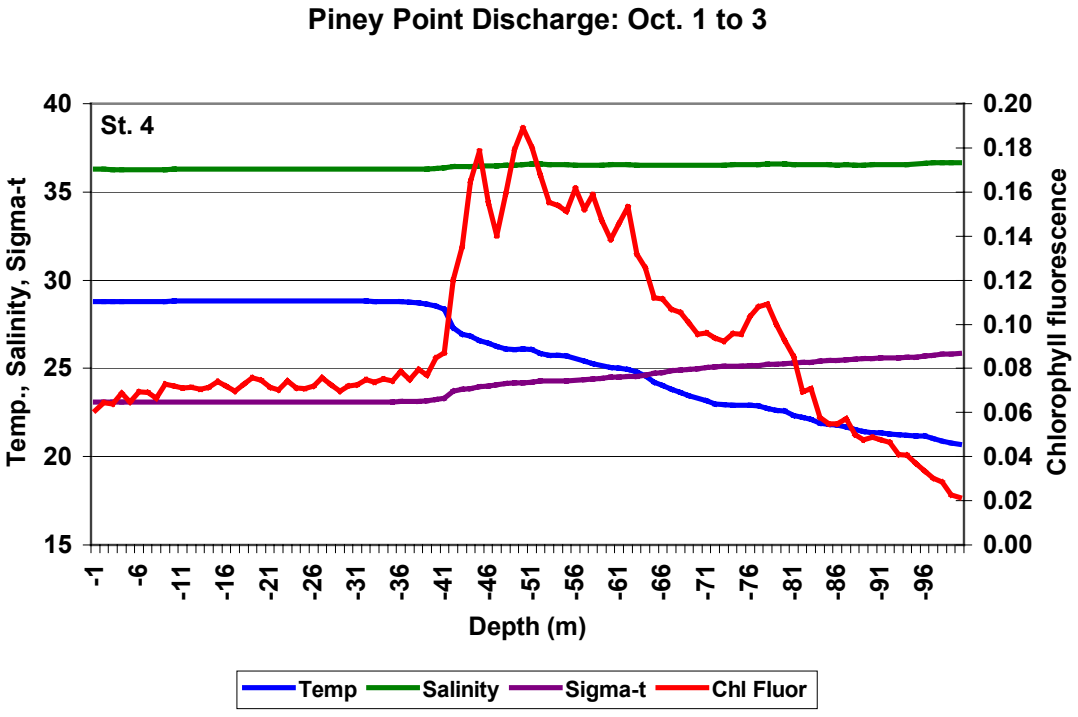
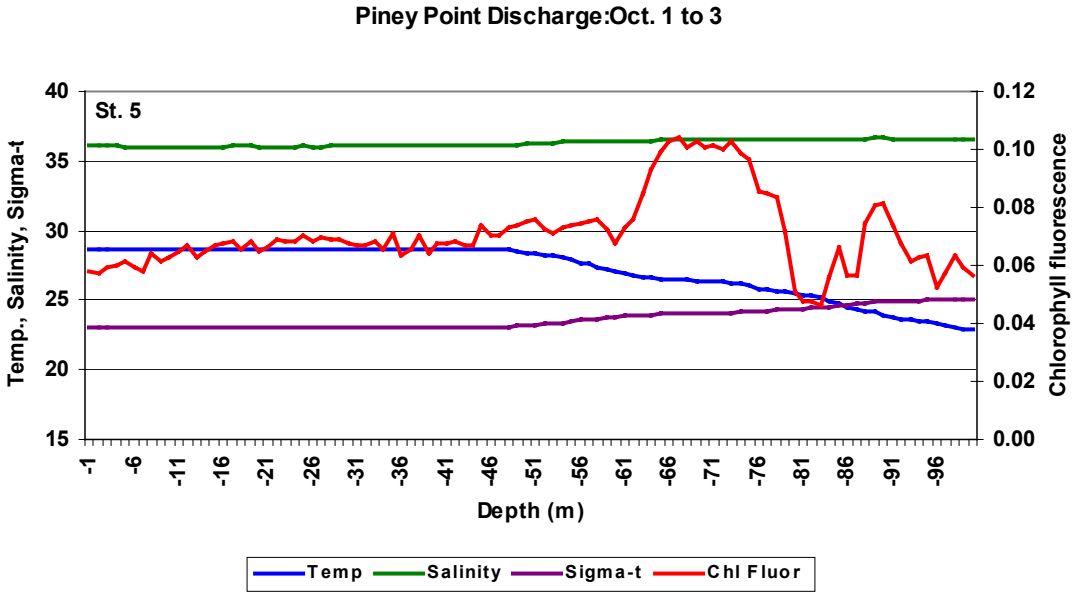
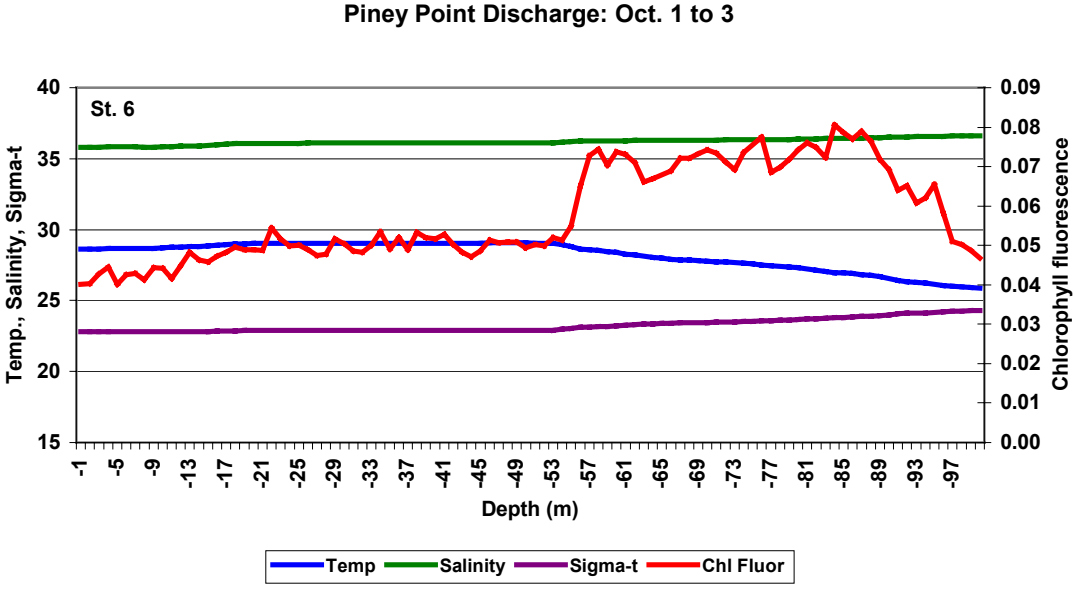
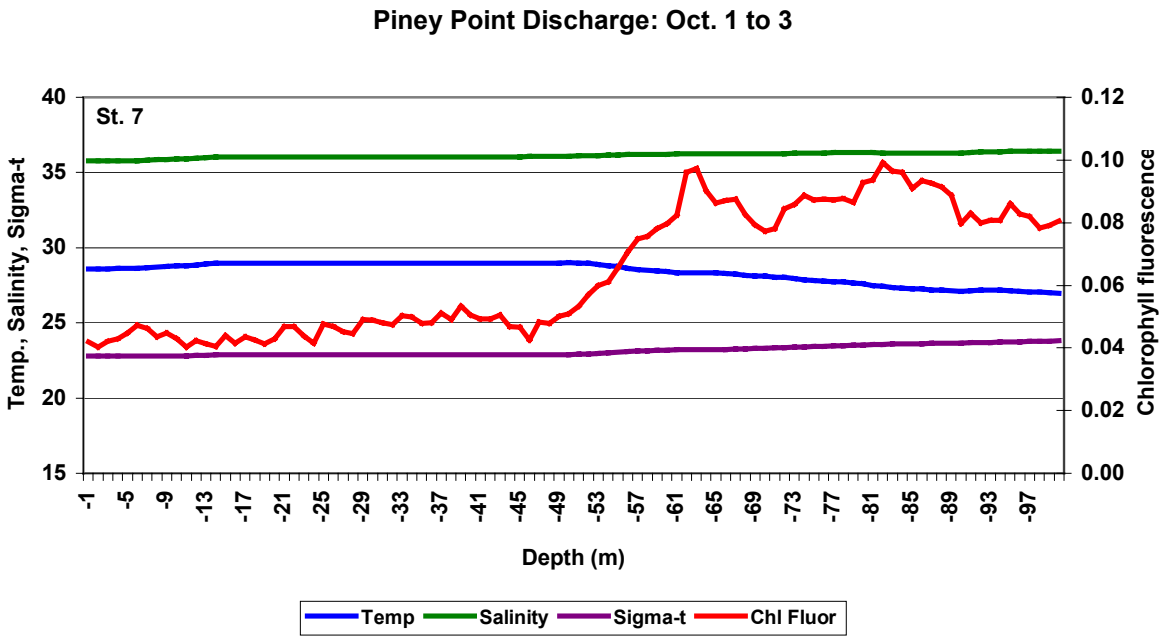
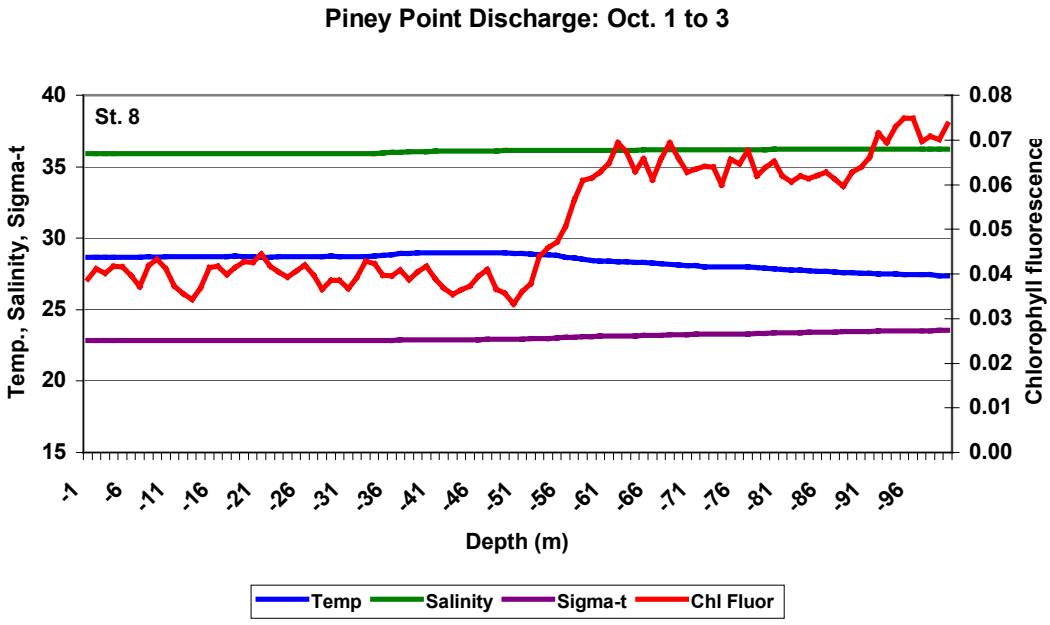
St. 3
Temp., Salinity, Sigma-t
Chlorophyll fluorescence
Depth (m)
Temp
Salinity
Sigma-t
Chl Fluor


Piney Point Discharge: Oct. 1 to 3
St. 4
Temp., Salinity, Sigma-t
Chlorophyll fluorescence
Depth (m)
Temp
Salinity
Sigma-t
Chl Fluor

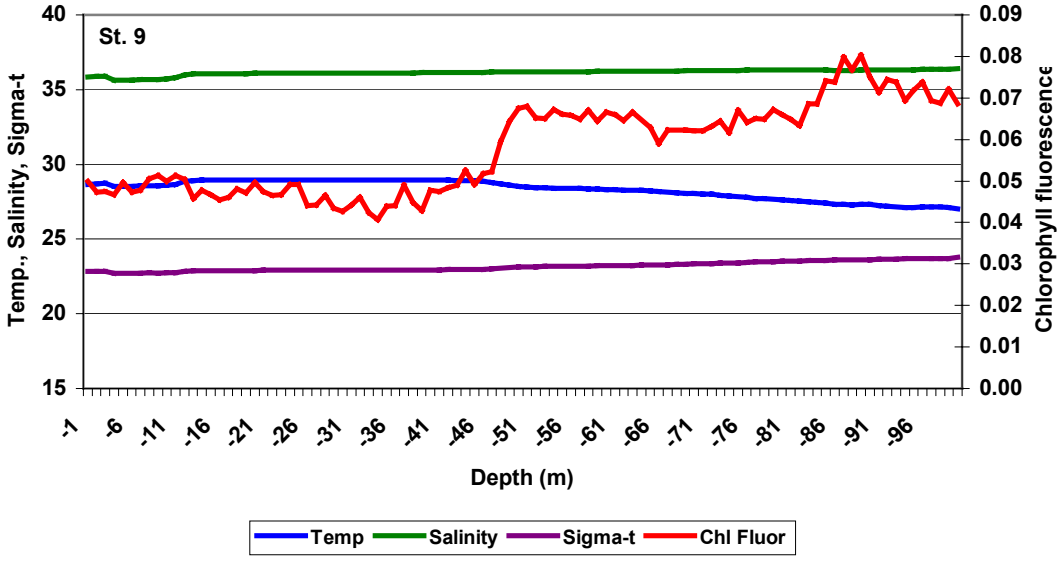

Piney Point Discharge:Oct. 1 to 3
St. 5
Temp., Salinity, Sigma-t
Chlorophyll fluorescence
Depth (m)
Temp
Salinity
Sigma-t
Chl Fluor


Piney Point Discharge: Oct. 1 to 3
St. 6
Temp., Salinity, Sigma-t
Chlorophyll fluorescence
Depth (m)
Temp
Salinity
Sigma-t
Chl Fluor

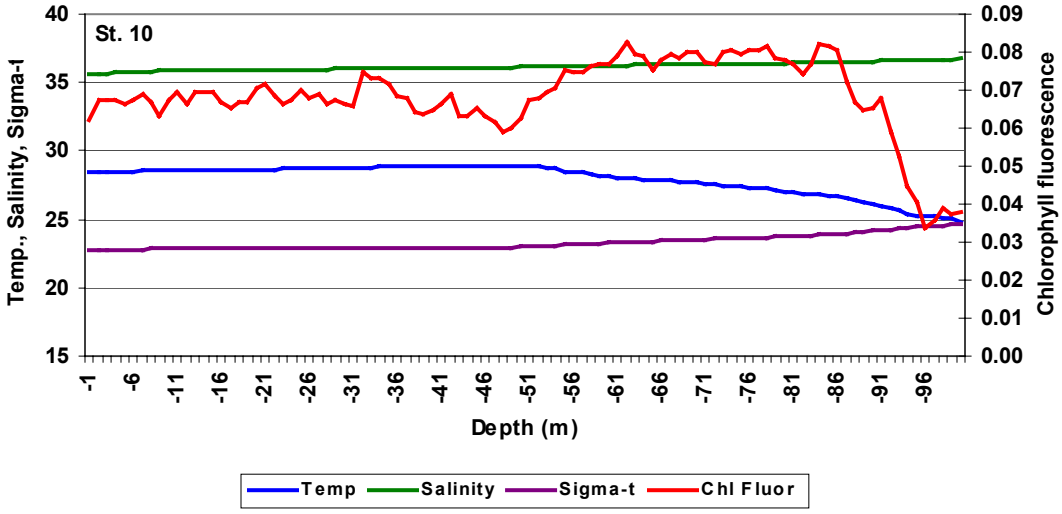

Piney Point Discharge: Oct. 1 to 3
St. 7
Temp., Salinity, Sigma-t
Chlorophyll fluorescence
Depth (m)
Temp
Salinity
Sigma-t
Chl Fluor


Piney Point Discharge: Oct. 1 to 3
St. 8
Temp., Salinity, Sigma-t
Chlorophyll fluorescence
Depth (m)
Temp
Salinity
Sigma-t
Chl Fluor

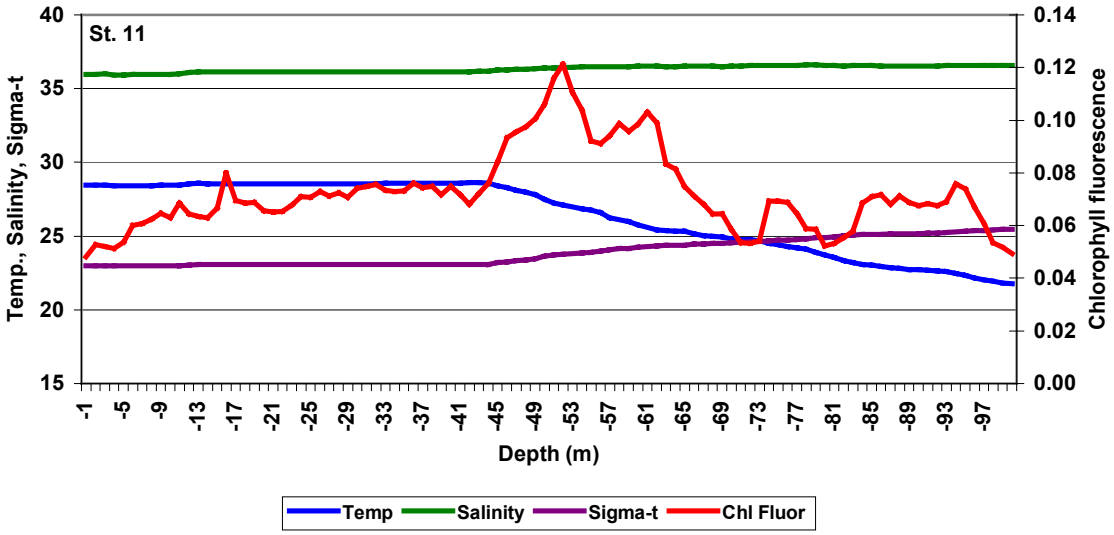
Piney Point Discharge: Oct. 1 to 3



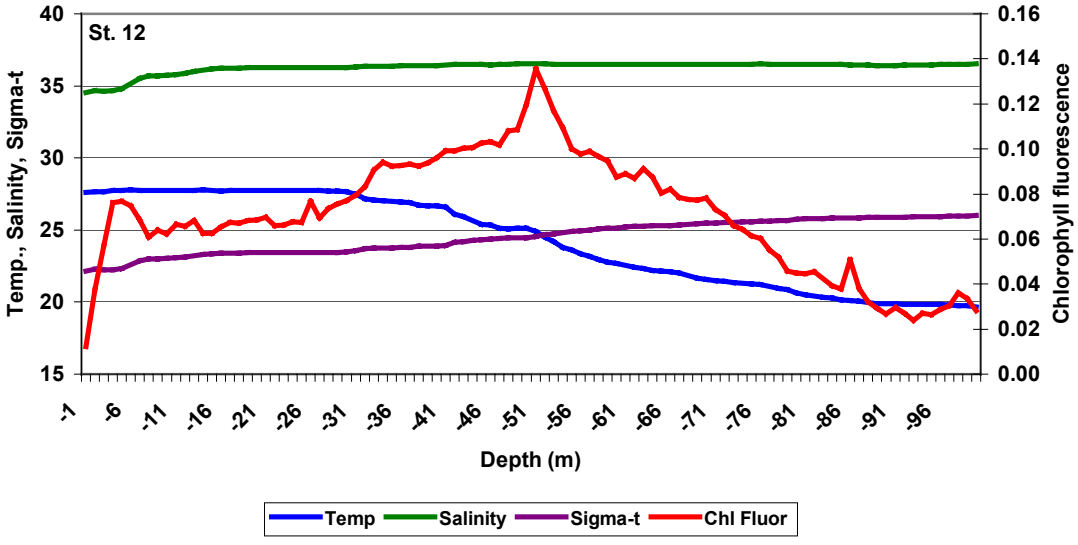
Piney Point Discharge: Oct. 1 to 3



Piney Point Discharge: Oct. 1 to 3



Piney Point Discharge: Oct. 1 to 3



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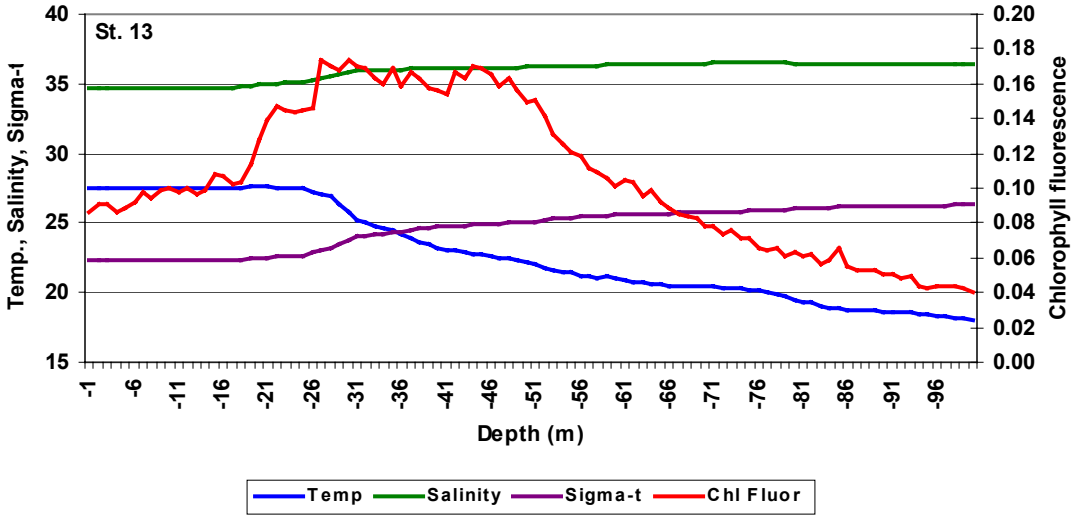
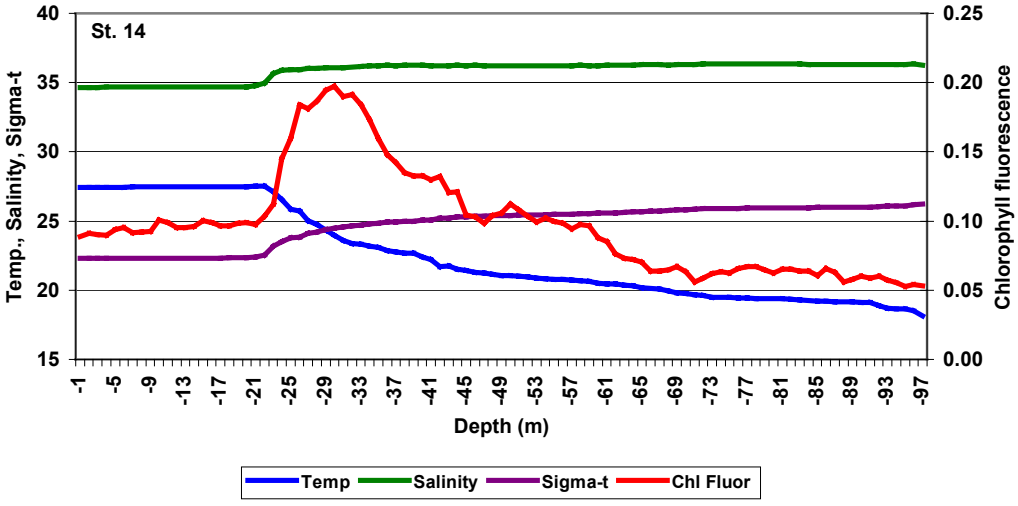
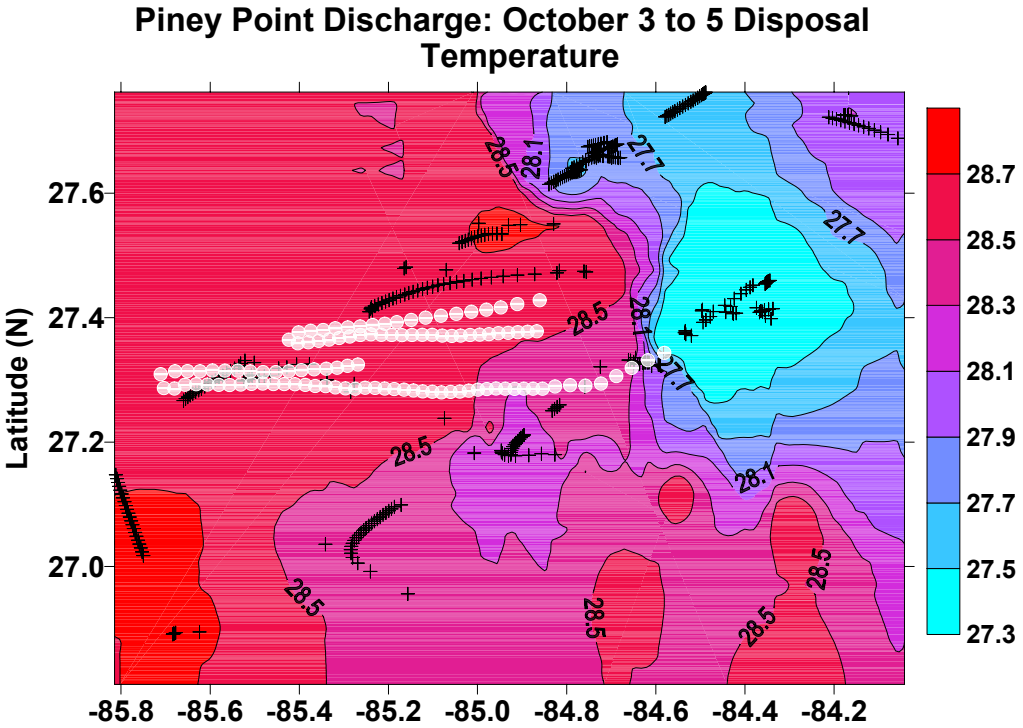
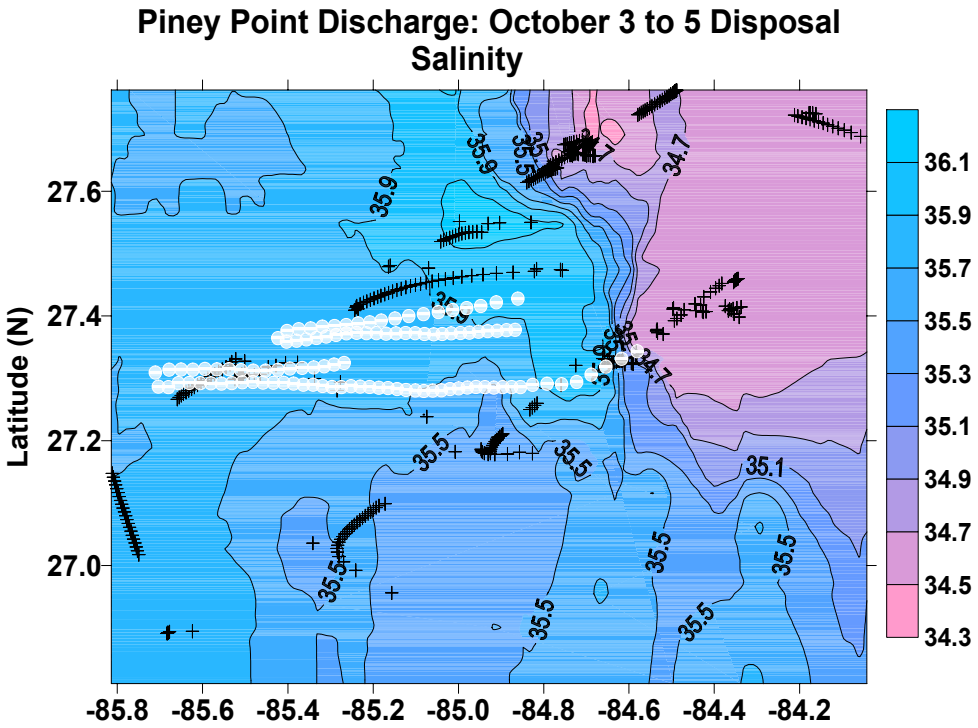
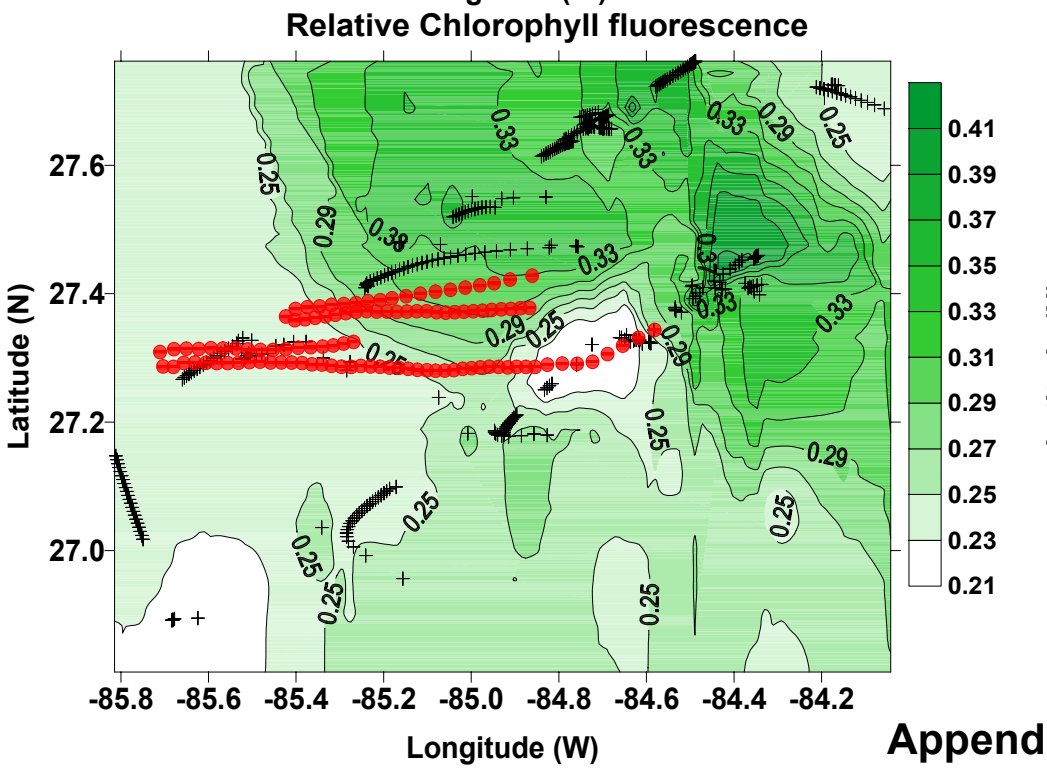


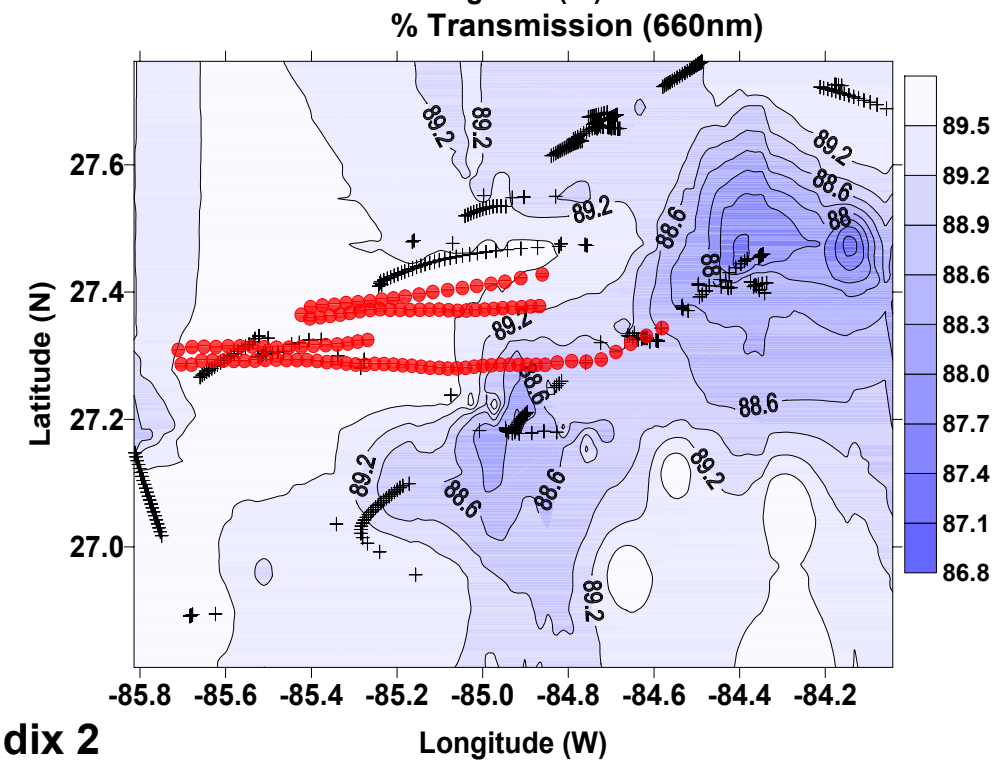
Piney Point Discharge: Oct. 1 to 3




Piney Point Discharge: October 3 to 5 Disposal
Temperature
Latitude (N)
Longitude (W)
27.6
27.4
27.2
27.0
-85.8 -85.6 -85.4 -85.2 -85.0 -84.8 -84.6 -84.4 -84.2
28.7
28.5
28.3
28.1
27.9
27.7
27.5
27.3


Piney Point Discharge: October 3 to 5 Disposal
Salinity
Latitude (N)
Longitude (W)
27.6
27.4
27.2
27.0
-85.8 -85.6 -85.4 -85.2 -85.0 -84.8 -84.6 -84.4 -84.2
36.1
35.9
35.7
35.5
35.3
35.1
34.9
34.7
34.5
34.3


Relative Chlorophyll fluorescence
Latitude (N)
Longitude (W)
27.6
27.4
27.2
27.0
-85.8 -85.6 -85.4 -85.2 -85.0 -84.8 -84.6 -84.4 -84.2
0.41
0.39
0.37
0.35
0.33
0.31
0.29
0.27
0.25
0.23
0.21


% Transmission (660nm)
Latitude (N)
Longitude (W)
27.6
27.4
27.2
27.0
-85.8 -85.6 -85.4 -85.2 -85.0 -84.8 -84.6 -84.4 -84.2
89.5
89.2
88.9
88.6
88.3
88.0
87.7
87.4
87.1
86.8

Appendix 2

Piney Point Discharge Survey
October 1 - 3, 2003

Extracted Chlorophyll-a concentrations

Date	Latitude	Longitude	Station	Depth	CHL ug/L	Avg CHL ug/L	Phaeo ug/L	Avg PH ug/L	Comments
10/1/2003	27 45.735	-84 29.186	1	0	0.36	0.35	0.25	0.22	Fo is estimated (2X Fa) - Fluor cell not seated correctly - Fa reading correct - 1 Puff
10/1/2003	27 45.735	-84 29.186	1	0	0.34		0.20		Fo is estimated (2X Fa) - Fluor cell not seated correctly - Fa reading correct - 1 small puff
10/1/2003	27 45.735	-84 29.186	1	10	0.36	0.33	0.12	0.15	Fo is estimated (2X Fa) - Fluor cell not seated correctly - Fa reading correct
10/1/2003	27 45.735	-84 29.186	1	10	0.31		0.17		Fo is estimated (2X Fa) - Fluor cell not seated correctly - Fa reading correct
10/1/2003	27 45.735	-84 29.186	1	45	0.57	0.58	0.34	0.36	Fo is estimated (2X Fa) - Fluor cell not seated correctly - Fa reading correct
10/1/2003	27 45.735	-84 29.186	1	45	0.59		0.38		Fo is estimated (2X Fa) - Fluor cell not seated correctly - Fa reading correct
10/1/2003	27 41.462	-84 39.451	2	0	0.38	0.38	0.24	0.23	Sample taken from flow through at sink due to CTD/rosette problems
10/1/2003	27 41.462	-84 39.451	2	0	0.37		0.22		Sample taken from flow through at sink due to CTD/rosette problems
10/1/2003	27 37.654	-84 49.441	3	0	0.38	0.37	0.18	0.18	Sample taken from flow through at sink due to CTD/rosette problems
10/1/2003	27 37.654	-84 49.441	3	0	0.37		0.18		Sample taken from flow through at sink due to CTD/rosette problems
10/1/2003	27 33.095	-84 59.859	4	0	0.30	0.29	0.23	0.24	Sample taken from flow through at sink due to CTD/rosette problems
10/1/2003	27 33.095	-84 59.859	4	0	0.28		0.25		Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 28.764	-85 09.924	5	0	0.28	0.27	0.23	0.22	Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 28.764	-85 09.924	5	0	0.26		0.21		Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 19.926	-85 30.31	6	0	0.18	0.18	0.14	0.15	Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 19.926	-85 30.31	6	0	0.17		0.15		Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 11.555	-85 50.234	7	0	0.21	0.22	0.18	0.16	Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 11.555	-85 50.234	7	0	0.22		0.14		Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	26 53.422	-85 41.140	8	0	0.21	0.21	0.16	0.16	Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	26 53.422	-85 41.140	8	0	0.20		0.15		Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 02.211	-85 20.686	9	0	0.24	0.25	0.17	0.17	Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 02.211	-85 20.686	9	0	0.25		0.17		Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 10.949	-85 00.421	10	0	0.29	0.29	0.23	0.22	Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 10.949	-85 00.421	10	0	0.30		0.22		Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 15.291	-84 50.238	11	0	0.34	0.33	0.20	0.23	Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 15.291	-84 50.238	11	0	0.32		0.25		Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 19.693	-84 40.111	12	0	0.37	0.36	0.23	0.23	Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 19.693	-84 40.111	12	0	0.34		0.24		Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 24.103	-84 30.030	13	0	0.37	0.38	0.27	0.25	Sample taken from flow through at sink due to CTD/rosette problems
10/2/2003	27 24.103	-84 30.030	13	0	0.38		0.23		Sample taken from flow through at sink due to CTD/rosette problems
10/3/2003	27 28.514	-84 20.121	14	0	0.36	0.37	0.28	0.26	Sample taken from flow through at sink due to CTD/rosette problems
10/3/2003	27 28.514	-84 20.121	14	0	0.39		0.25		Sample taken from flow through at sink due to CTD/rosette problems

Fractioned CHL

						% of Total		% of Total	
10/1/2003	27 45.735	-84 29.186	1	0	0.26	75.15	0.14	64.55	<5um size fraction
10/1/2003	27 45.735	-84 29.186	1	0	0.04	10.48	0.02	9.79	>5um size fraction
10/1/2003	27 37.654	-84 49.441	3	0	0.23	62.87	0.19	106.74	<5um size fraction
10/1/2003	27 37.654	-84 49.441	3	0	0.05	12.91	0.01	7.84	>5um size fraction
10/2/2003	27 11.555	-85 50.234	7	0	0.19	86.22	0.15	92.42	<5um size fraction
10/2/2003	27 11.555	-85 50.234	7	0	0.02	10.74	0.01	8.09	>5um size fraction
10/2/2003	27 02.211	-85 20.686	9	0	0.20	78.02	0.15	90.45	<5um size fraction
10/2/2003	27 02.211	-85 20.686	9	0	0.01	5.94	0.02	8.97	>5um size fraction
10/2/2003	27 15.291	-84 50.238	11	0	0.25	75.37	0.19	83.87	<5um size fraction
10/2/2003	27 15.291	-84 50.238	11	0	0.06	18.92	0.02	10.03	>5um size fraction
10/2/2003	27 24.103	-84 30.030	13	0	0.30	81.25	0.24	93.18	<5um size fraction
10/2/2003	27 24.103	-84 30.030	13	0	0.04	10.49	0.03	10.27	>5um size fraction

Table 2: Piney Point Discharge surface chlorophyll values for all cruises.

	Chlorophyll (ug/l) at the surface													
Date	St 1	St. 2	St 3	St 4	St 5	St 6	St 7	St 8	St 9	St 10	St 11	St 12	St. 13	St 14
9-Jul	0.16	0.21	0.16	0.26	0.20	0.59	0.39	0.14	0.09	0.20	0.20	0.22	0.28	0.43
28-Jul	0.14	0.13	0.18	0.23	0.35	0.48	0.43	0.09	0.34	0.34	0.20	0.13	0.11	0.10
18-Aug	0.14	0.19	0.15	0.15	0.25	0.13	0.21	0.31	0.14	0.15	0.26	0.30	0.18	0.18
27-Aug	0.15	0.19	0.18	0.17	0.21	0.16	0.10	0.09	0.21	0.15	0.17	0.19	0.15	0.13
3-Sep	0.19	0.22	0.18	0.16	0.28	0.17	0.19	ND	0.13	0.20	0.25	0.22	0.31	0.27
1-Oct	0.38	0.38	0.37	0.29	0.27	0.18	0.22	0.21	0.25	0.29	0.33	0.36	0.38	0.37

HAB October
FWC - Florida Marine Research Institute
Summary for Phytoplankton Bloom Sample Analysis

Sample Date: 10/1/03-10/2/03 Sample Location: Piney Point Transect, Gulf of Mexico
Collected by: USF/DEP Reason Collected: routine
Salinity: 34-36ppt Received as: live and lugols
Sample #:PP0309A -01 thru 14, except 8 HAB Sample # 031003-(2-17)
Analysis Date: 10/3/03 Investigator: E. Truby and J. Wolny

Further Analyses Conducted: None

Results Reported to: Charles Kovach, DEP; Danylle Spence, USF; Bev Roberts, FWC; George Henderson, FWC

Analysis of the 16 live samples and 16 preserved samples from Transect 6 of the Piney Point Discharge Program showed no presence of Karenia brevis or other harmful algal bloom species.

Due to equipment failure only surface water samples were taken for Stations 2-14. Screening of the live and preserved samples provided the species identifications. Counts were done from Lugols preserved samples only. Discrepancies between the two sample types occur when low numbers of a particular species are observed in one sample type or the other, not both.

Summary Provided By: J. Wolny, FMRI
Summary for Phytoplankton Bloom Sample Analysis: Jennifer Wolny